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ABSTRACT

This report to the United States Senate deals with the systems and procedures used by various federal agencies to award research funds to universities and the resulting distribution of those funds. More specifically, it is intended to review previous studies of the relationship between the award process and distribution of federal research funds, and to describe certain award procedures of the National Institutes of Health (NIH) and the National Science Foundation (NSF). The document is divided into ten sections. The first two sections provide general background on peer review. Sections three through six describe the NSF and NIH award processes, focusing on the role of external peer reviewers and internal agency officials. The remaining four sections address the issues of fairness and accountability in the awards processes, including what past studies have shown about peer reviews. The appendices include a selected bibliography of studies of peer review, listings of resources and criteria used by NSF and NIH when selecting peer review committees, and a breakout of NSF and NIH support given to under-represented groups, institutions, women, and minorities. (TW)

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United States General Accounting Office

GAO

Fact Sheet for the Ranking Minority Member, Committee on Appropriations, United States Senate

March 1987

UNIVERSITY FUNDING

Information on the Role of Peer Review at NSF and NIH

ED284732

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United States
General Accounting Office
Washington, D.C. 20548

Resources, Community, and
Economic Development Division

B-221714

March 26, 1987

The Honorable Mark O. Hatfield
Ranking Minority Member, Committee
on Appropriations
United States Senate

Dear Senator Hatfield:

This fact sheet responds to your December 17, 1985, request that we examine the systems and procedures used by various federal agencies to award research funds to universities and the resulting distribution of those funds. In discussions with your office, we agreed to (1) determine the distribution of federal research funds to universities and colleges by institution, state, agency, and field of science, (2) analyze the extent to which patterns of distribution are accounted for by historical trends, direct congressional action, field of science, demographic and socioeconomic factors, and the use and distribution of peer reviewers, (3) review previous studies of the relationship between the award process and distribution of federal research funds, and (4) describe certain award procedures at the National Institutes of Health (NIH) and the National Science Foundation (NSF).

A companion report (GAO/RCED-87-67BR) covers points one and two and this fact sheet addresses points three and four. Our purpose is to describe the formal policies and procedures at NIH and NSF for making research awards. Due to congressional concern about the fairness and effectiveness of that part of the award process known as "peer review," we particularly focus on the role assigned to external scientists who review the research applications (i.e., the peer reviewers). In doing this work, we did not evaluate the agencies' award policies and procedures, nor did we review how well agency officials implement them.

This fact sheet is divided into 10 sections. The first two sections provide general background on peer review; sections three through six describe the NSF and NIH awards processes, focusing on the role of external peer reviewers and internal agency officials; and the remaining sections address the

issues of fairness and accountability in the awards processes, including what past studies have shown about peer review.

We obtained information on NSF and NIH review processes by examining agency and congressional hearing documents, interviewing federal agency officials ranging from program officers to senior management officials in the Washington, D.C., area, and reviewing past studies on the award decision processes. We discussed a draft of this fact sheet with responsible NIH and NSF officials who generally agreed with its contents. Their technical comments have been incorporated where appropriate.

We are sending copies of this fact sheet to relevant committees of the Congress, the Director of NIH, the Director of NSF, and to other interested parties upon request. If you have additional questions or if we can be of further assistance in this matter, please contact me at (202) 275-1000.

Major contributors are listed in Appendix X.

Sincerely yours,

Sarah P. Frazier

Sarah P. Frazier
Associate Director

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ABBREVIATIONS

DRG	Division of Research Grants (NIH)
GAO	General Accounting Office
HHS	Department of Health and Human Services
NIH	National Institutes of Health
NSF	National Science Foundation
ONR	Office of Naval Research
R&D	research and development

SECTION 1

What is the "peer review" system used by federal agencies to award research grants and how did it begin?

Many federal agencies funding research at universities ask for the advice of expert professionals, or "peers" of investigators on grant applications, to help them decide which proposed projects to fund. This part of the agencies' decision-making process is known as a peer review system.

Peer review in science began at least 300 years ago, when the members of the Royal Society in England adopted a referee system to evaluate papers for publication. Currently, peer review is used principally in three ways: first, to assist in choosing which research projects should be funded; second, to select which research papers should be published in a journal or other publication; and third, to judge the findings in an area of science or technical information, such as when a decision must be made on potential regulations or priorities for agency programs. This report focuses on the first.

In the United States, the establishment of the National Advisory Cancer Council in 1937 marked the beginning of federal use of peer review. The Council was authorized to review applications for research funding and to certify approval to the Surgeon General for projects that had the potential of significantly contributing to knowledge about cancer. The Office of Naval Research (ONR) also used peer review to assist in its university research funding in the late 1940's. ONR grants managers would informally seek advice by experts in the field when reviewing applications for research funding. ONR's approach was later adopted and formalized by the National Science Foundation (NSF); NSF's peer review process elicits written comments from external peers.

Currently, within the National Institutes of Health (NIH) and NSF, external peer review is relied upon predominantly in awarding research projects.[1] Other agencies vary considerably in

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[1]An advisory committee appointed to assess NSF's peer review system, in a report to the Director, NSF (Final Report. NSF Advisory Committee on Merit Review, September 25, 1986), recommended that NSF adopt the term "merit review" to describe its award selection process. Merit review, according to the Director's Statement in the report, takes into account the evolution of the peer review process, whereby the changing scale and organization of science have increased the importance of factors other than scientific merit on the award decision process. See section 7 of this fact sheet for discussion of some of these factors.

how they assess the merit of proposals, with practices that may include obtaining the advice of external peers, internal experts, or program staff.

SECTION 2

Why is peer review controversial?

Peer review is an inexact, subjective process in which scientists judge which researchers and which proposals are most likely to yield the most fruitful results. Common criticisms of the present federal use of peer review are:

-- Institutions concentrated in the East, the Midwest, and the West historically have received the major share of federal research funds. (During the mid 1940's, geographic concentration of university research was one of the major points of congressional hearings on a bill that was introduced to establish NSF.)[2]

-- Peer review ". . . is an 'old boys' system' where program managers rely on trusted friends in the academic community to review their proposals. These friends recommend their friends as reviewers. . . . It is an incestuous 'buddy system' that frequently stifles new ideas and scientific breakthroughs."[3] Sixty-three percent of the approximately 4,100 scientists who responded to a 1986 Sigma Xi (a national honorary scientific society) survey agreed with the statement that "Procurement procedure for grants to do governmentally sponsored research depends on 'who you know'. Many requests seem to be funded primarily because the researchers are already known to and supported by the granting organizations."[4]

-- Peer review and the present grants system in general are

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[2]See our companion report, University Funding: Patterns of Distribution of Federal Research Funds to Universities, (GAO/RCED-87-67BR), for analysis of present federal research funding patterns. This report states that although distribution of total federal research funds to institutions is concentrated in a few states and institutions, related factors, such as fields of science and population, influence the patterns of distribution.

[3]Representative John Conlan, National Science Foundation Peer Review: Special Oversight Hearings, Subcommittee on Science, Research, and Technology, Committee on Science and Technology, U.S. House of Representatives, 94th Congress, 1st session, page 5.

[4]See A New Agenda for Science (preliminary report), New Haven, Connecticut: Sigma Xi, The Scientific Research Society, 1986, p. 39.

too conservative.[5] Additionally, peer review is not appropriate for selecting proposals that are either particularly innovative or incorporate interdisciplinary research.[6]

-- The paperwork and time spent by reviewers detracts too much from the national research effort. Established scientists undertaking worthy research should receive awards for longer periods with less need for lengthy documentation in requests for initial awards and for renewals.[7]

Despite these views, peer review has been continually and overwhelmingly endorsed as the best method of assuring that the best research is funded. Polls of researchers have yielded strong support for the use of external peers to assist federal agencies in determining which proposals should be funded. For example, 86 percent of the respondents in the above-mentioned Sigma Xi survey favored the use of peer review in research programs. Additionally, in studies over the past 30 years, panels of distinguished scientists, presidential commissions, and numerous witnesses at congressional hearings have endorsed the use of peer review.[8] (See sec. 10 for a summary of studies; see app. I for a selected list of studies.)

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[5]See Rustum Roy, "Funding Science: The Real Defects of Peer Review and the Alternative to It," Science, Technology, and Human Values, 10(3): 73-78, 1985.

[6]See A.L. Porter and F.A. Rossini, "Peer Review of Interdisciplinary Research," Science, Technology, and Human Values, 10(3):33-38, 1985.

[7]See Rustum Roy, "Funding Science: The Real Defects of Peer Review and An Alternative To It," Science, Technology, and Human Values, 10 (3): 74, 1985.

[8]The most recent endorsement of the peer review system is by the NSF Advisory Committee on Merit Review. In its 1986 report, the Director, NSF, states that the peer review system "has been found to be remarkably effective and flexible, adapting to the changing needs of science and engineering research, and incorporating improvements with respect to openness, accountability, equity, and impact on the research environment." See Final Report. NSF Advisory Committee on Merit Review, NSF, September 25, 1986.

SECTION 3

How do NSF and NIH select research projects for award to universities and colleges?

This section describes NSF's and NIH's processes for awarding research grants to individual university scientists.[9]

NSF PROJECT SELECTION PROCESS

Objectives in selecting projects

NSF's project selection process for awarding individual project grants is designed to select projects that are perceived to be of the highest scientific and technical merit. It is also designed to encourage wider participation from under-represented groups and institutions and to support innovative, high-risk research.[10]

Project selection process

During fiscal year 1985, NSF took final action on 24,403 competitively reviewed proposals. Of these, 7,968 were awarded; almost twice as many, 15,504, were declined; and 931 were withdrawn by applicants prior to a decision.[11] Nearly all of the awards were for individual project grants; the average award was $75,000 in total costs.

The system that NSF has established to decide which individual grant proposals to award is shown in figure 3.1. A brief description of the process follows.

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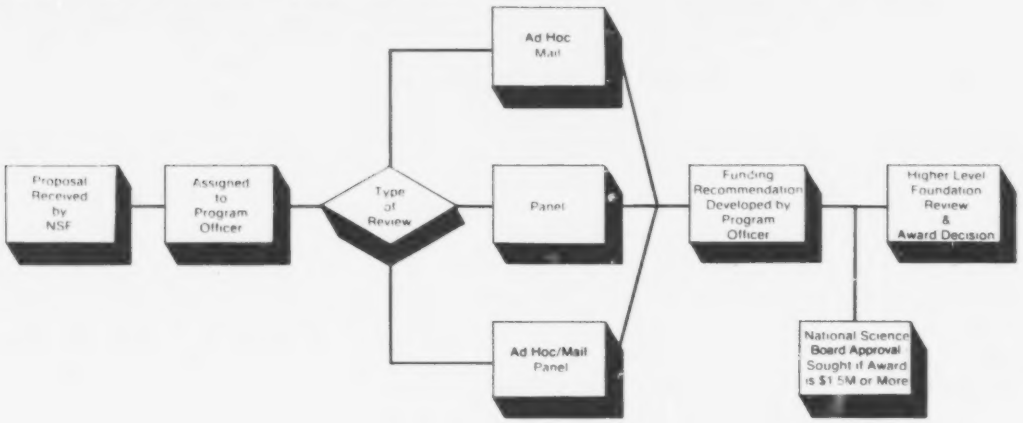
[9]This fact sheet focuses on the selection processes of the dominant funding mechanism used by both NSF and NIH, namely, the project grant awarded to the individual university investigator. For a discussion of federal funding mechanisms and the relative emphasis federal agencies place on them, see our report University Funding: Federal Funding Mechanisms in Support of University Research (GAO/RCED-86-53, February 1986).

[10]The terms "underrepresented groups and institutions" and "innovative, high-risk research" are defined in section 7.

[11]Testimony delivered by Dr. Mary Clutter, NSF Senior Science Advisor, on April 9, 1986, before the Task Force on Science Policy, Committee on Science and Technology, House of Representatives.

Figure 3.1: Key Steps in the NSF Project Selection Process


Proposal Received by NSF
Assigned to Program Officer
Type of Review
Ad Hoc Mail
Panel
Ad Hoc/Mail Panel
Funding Recommendation Developed by Program Officer
Higher Level Foundation Review & Award Decision
National Science Board Approval Sought if Award is $1.5M or More

Source: GAO, based on agency documents and other publicly available sources.

Most grant proposals received by NSF are unsolicited. When received, proposals are assigned to officers within program divisions according to their field of science or engineering. After receiving the proposal, the program officer gives a preliminary assessment, selects external peer reviewers, usually from universities (sometimes from industry), and asks them to provide a scientific assessment in the form of a written critique and overall rating.[12]

In receiving external advice from peer scientists, the program officer generally uses one of three procedures: ad hoc mail review, review by panel only, or a combination of mail and panel review. In ad hoc mail review, the program officer sends the proposal to several people (sometimes as many as ten), along with instructions and reviewing forms that contain the criteria they should use in evaluating the proposal. On the average, each proposal is actually reviewed by five to six people. In panels only, the program officer typically assembles 8 to 12 reviewers to orally critique the proposals; this approach is mostly used when a sizable number of standard proposals are submitted for special programs, such as the Presidential Young Investigator

[12]See section 4 for a discussion of who the peer reviewers are at NSF and NIH and how they are chosen.

Awards. In a combination of ad hoc mail review and panels, the program officer sends the proposals out to both mail reviewers and to panelists. The panelists then meet in Washington to evaluate the proposals, also taking into account the comments of the ad hoc mail reviewers.

After receiving external peer evaluations, the program officer evaluates the proposals, taking into consideration both external peer comments and ratings and his or her own judgment of scientific merit. He or she also considers other factors, such as underrepresented researchers, less research-intensive institutions, and innovative, high-risk research, before recommending whether an award should be made.

The program officer's recommendation is then reviewed at one or possibly two higher levels (section and/or division) before an official decision is made. At these higher review levels, the program officer's recommendation can be questioned, returned for more documentation, or overturned (according to NSF officials, the latter is rare). For awards of at least $1.5 million annually, or of a total commitment of $6 million, the National Science Board, the body charged by statute with establishing NSF policies, must review the staff decision before an award can be made.

NIH PROJECT SELECTION PROCESS

Objectives in selecting projects

NIH selects research projects with the intent of funding biomedical research of the highest scientific and technical merit. NIH also selects projects with the intent of supporting research relevant both to its own research program needs and to larger societal health concerns.

Project selection process

In fiscal year 1986, NIH reviewed 19,119 competitive research project grant applications. Of these, 13,682 were new and 5,105 were competitive renewals (i.e., applications seeking renewal contingent upon another peer review), and 332 were competitive supplements. About a quarter of the new applications and a little over half of the renewals were funded. Most of these applications were for unsolicited individual research project grants; the average award was $149,532 in total costs.[13]

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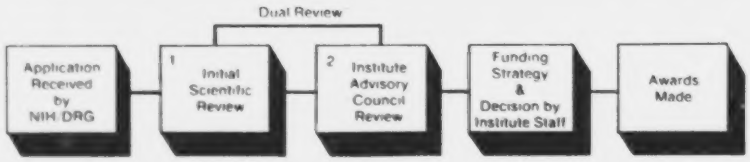
[13]Excluded from the above counts are withdrawals that occur before the advisory council meets, applications subsequently amended, resubmitted, and reviewed during fiscal year 1986, and all other applications that are not defined as research projects.

The mechanism NIH uses to review all grant applications is called the "dual review" system. Dual review refers to scientific peer review of project applications by "initial review groups" and then a second review by statutorily mandated institute advisory councils or boards.

The NIH project selection process is shown in figure 3.2 and a description of the key steps in this process follows.

Figure 3.2: Key Steps in the NIH Project Selection Process


Dual Review
Application Received by NIH DRG
1 Initial Scientific Review
2 Institute Advisory Council Review
Funding Strategy & Decision by Institute Staff
Awards Made

Source: GAO, based on agency documents and other publicly available sources.

Application assignment

Applications sent to NIH are first received at the Division of Research Grants (DRG)[14] that reports to the Director of NIH and is located outside of the individual program institutes that make the award. Referral officers within DRG assign applications to one of approximately 90 DRG peer review committees, called initial review groups or study sections, that are organized by specific fields of research (e.g., molecular biology, nutrition, biochemistry). They also assign the application to the relevant funding institute, bureau, or division within NIH.

Initial review for scientific merit

Most competing project applications are first peer-reviewed for scientific and technical merit within DRG study sections that meet on or near the NIH campus three times a year.[15] During these meetings, peer reviewers discuss each application using

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[14]DRG serves as a staff resource for central receipt, assignment, and referral to the institutes of all applications for Public Health Service research and training support. It also provides the initial scientific review for most NIH research grants.

[15]Individual NIH institutes also manage peer review of some applications in initial review groups similar to those managed by DRG.

evaluation criteria that NIH developed, and then vote whether the application has sufficient merit to warrant funding. Individual peer reviewers then assign each application voted worthy of funding a priority rating from which NIH staff compute an overall priority score. This score becomes part of each application's "summary statement" that is sent to the next level for review.

Institute and advisory council review for program relevance

Each institute has its own statutorily mandated advisory council that reviews the summary statements, and where necessary, the applications, before recommending approval for funding. The advisory councils are made up of scientists and lay persons who recommend action on most applications by voting "en bloc" concurrence with the recommendations of the initial review groups or study sections. According to NIH officials, less than 10 percent of the applications are individually singled out for special discussion (e.g., high program relevancy; special health-related need; inappropriate peer review; foreign applications; ethical issues) at the advisory council meetings.

Institute staff develop funding strategy

Once the advisory council has acted on the initial review groups' or study sections' recommendations, or taken special action, institute staff rank the approved proposals based on their priority scores (or percentile values derived from them) to initiate a funding strategy based on available institute funds. Since scientific merit is not the only criterion used in making funding decisions, lower-rated proposals that are identified as having particular value, such as high relevance to NIH program needs, may be funded in place of higher-rated proposals. According to NIH officials, about 1 to 2 percent of the applications are funded in this way.

SECTION 4

Who are the peer reviewers and how are they chosen?

While most of the peer reviewers that NSF and NIH ask to serve are active research scientists employed by universities as faculty members, some others are scientists in research institutes, government, or private industry. We will briefly describe, for NSF and for NIH, who they are, the resources used to recruit them, and the criteria used to select them.

NSF PEER REVIEWERS

According to April 1986 testimony by NSF's senior science advisor, in fiscal year 1985 NSF asked 59,725 persons to serve as reviewers and panelists, reviewing approximately 24,000 proposals. They came from a wide range of institutions, including large and small academic institutions, industry, government, and foreign research and educational organizations. A list of NSF reviewers and advisory panel members is available annually.

How NSF peer reviewers are recruited

NSF policy guidelines caution against too frequent use of any one reviewer, urging program officers to "constantly seek referrals of new persons for future use as reviewers."[16] According to NSF testimony and what NSF officials told us, program officers look for qualified and knowledgeable reviewers from all backgrounds and use a variety of resources for recruiting them, ranging from lists of reviewers suggested by the applicants or current peer reviewers themselves, to contacts made by NSF staff at professional meetings. Appendix II contains a list of specific resources NSF officials have told us they use.

NSF peer review selection criteria

NSF has written criteria for selecting peer reviewers who review by mail and/or serve on panels.[17] The most important criterion is that the reviewer have appropriate knowledge of the science. Other written criteria include consideration for geographic and institutional balance and for the use of women and minorities. For panels, written criteria include consideration for age distribution and for balanced membership similar to that

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[16]NSF Proposal and Award Manual No. 10, Section 122.4(e).

[17]Mail reviewers are chosen by NSF program officers. Panel reviewers are nominated by NSF program officers and approved by higher level NSF officials.

for mail review. Appendix III summarizes specific NSF criteria for selecting peer reviewers.

NIH PEER REVIEWERS

NIH has approximately 2,700 active external peer reviewers as part of 155 advisory committees that meet three times a year at or near the NIH campus to review competitive project applications.[18] About 2,300 of these reviewers are members of initial review groups that assess the applications' scientific merit, and another 400 are on institute advisory councils and program advisory committees that assess their relevance to program and societal goals. The membership of these groups is published yearly in NIH Public Advisory Groups.

Most members who serve on initial review groups are active researchers at colleges and universities, over 50 percent of whom are full professors. Scientists who serve on an institute's advisory council or board are more senior and are chosen for their leadership in a discipline allied to the particular institute's mission. A large proportion are full professors, or university or medical school administrators, such as deans and vice presidents, and have served in other advisory roles for NIH in the past, particularly on the initial review groups.

Lay members of the advisory councils are private citizens who have demonstrated a special concern for a particular health problem and are usually active in related foundation or association work such as the American Cancer Society. Advisory committees also have a small percentage of government-employed scientists and private industry researchers.

Recruitment of initial peer reviewers

Membership in an initial peer review group is generally limited to 4 years. Since there are about 2,300 peer reviewers serving on initial peer review committees at any one time, 500-600 reviewers must be replaced each year. New members are nominated by the executive secretary of each committee and approved by the Director, NIH. Appendix IV provides details on the sources of names drawn upon.

Selection criteria for initial peer reviewers

The primary criterion for serving on an initial review group is demonstrated competence and achievement as an independent investigator in a scientific or clinical discipline or research

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[18]The 2,700 reviewers do not include those used on ad hoc panels or through mail review.

specialty. This may be measured by quality of research accomplished, publications, and other honors and activities. Other criteria include mature judgment and objectivity as well as the ability to participate adequately in the advisory group structure.

In addition, there are a number of constraints that influence the composition of the initial review groups. For example, there are specific numerical goals for state and regional representation and for representation of women and minorities. Written waiver requests are submitted for exceptions to these as well as other requirements.[19] Appendix V lists the NIH peer review selection criteria as well as constraints.

Recruitment of advisory council members

Whereas initial review group members are appointed by the Director, NIH, advisory council members, generally a third of whom are lay members and the remainder, physicians and scientists, are appointed by the Secretary, Department of Health and Human Services (HHS).[20] In addition to nominations from NIH, the Secretary receives potential names from Congress, special interest groups, other organizational components within HHS, and from the general public. Within this framework, the Secretary makes the final decisions concerning appointments and issues the invitation letter to the prospective member.

Selection criteria for council members

Advisory council or board members are chosen for their leadership in a discipline, their wide-ranging interests in a field, and their understanding of societal health needs.

In factoring geography and underrepresented groups into the selection of advisory council members, NIH officials told us that NIH adheres to a policy of putting at least one female and one minority member on each advisory council nomination slate. In addition, an institute director told us that selecting two people from the same state is avoided if at all possible.

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[19]In fiscal year 1986, approximately ten percent of the total number of NIH nominations contained waiver requests.

[20]The National Cancer Advisory Board is appointed by the President, not the Secretary, HHS.

SECTION 5

What are the peer reviewers asked to do?

In both NSF and NIH, peer reviewers are asked to evaluate the scientific merit of project applications using prescribed agency evaluation criteria and to provide this evaluation in written form and orally (if panels are used) to agency staff for their consideration in selecting projects for funding. Peer reviewers are also asked by both agencies to review project applications in the context of broader program and societal issues.

THE ROLE OF NSF PEER REVIEWERS

NSF officials ask peer reviewers to provide a written evaluation of the scientific and technical merit of a proposal using four NSF-wide proposal evaluation criteria:

-- research performance competence, that is, the technical soundness, the capability of the investigator, and the adequacy of institutional resources available for the work;

-- the intrinsic merit of the research, that is, the extent to which the proposal is expected to lead to new discoveries or fundamental advances in its field or across fields of research;

-- the utility or relevance of the research, that is, the extent to which the work could contribute to an extrinsic goal such as a new technology; and

-- the effect on the infrastructure of science and engineering, that is, what the work will contribute to the nation's research, education, and human resource base.

NSF officials we spoke with said that peer reviewers concentrate mostly on the first two criteria, commenting on the scientific method in the proposal and the capability of the investigator to carry it out. The third criterion is used more for applied research proposals, especially in the area of engineering, and the fourth criterion, according to some officials we spoke with, is not addressed very often by the external peer reviewers. The fourth criterion does, however, permit the program officer to evaluate and Foundation officials to award proposals because of their potential for improving the nation's research base (including women and minorities).

Peer reviewers participating in NSF's ad hoc mail procedure are asked to provide an overall rating of the proposal as well as

detailed written comments on a specific evaluation form that lists and describes the above four criteria. If participating in panels, peer reviewers orally discuss the merits of a group of proposals, with designated reviewers leading discussions and providing detailed written comments for certain proposals and a panel summary.

Once the peer reviewers have evaluated the proposals, their formal role ends. For those serving on panels, NSF provides travel expenses and usually a $100 per day honorarium. Ad hoc mail reviewers are not compensated.

THE ROLE OF NIH PEER REVIEWERS

As part of its dual review system, NIH has established two sequential levels of peer review panels with distinct roles. The first peer review panel, the initial review group, provides a scientific assessment of grant applications; decides by majority vote whether applications are worthy of funding; and may make budget and duration revisions when recommending applications for approval.

The second peer review group, the advisory council, assesses the quality of the initial scientific review; evaluates program priorities and relevance; and recommends to institute staff applications for award. Whether or not they are approved or disapproved by the initial review group, all applications above $50,000 direct costs each year go through the second level of review.

In order to evaluate the scientific and technical merit of each application, peer reviewers who conduct the initial review are given the following review criteria that are established by Public Health Service regulations. These criteria are

(1) the significance and originality of the proposal from a scientific and technical point of view,

(2) the adequacy of the methodology to carry out the research,

(3) the qualification and experience of the principal investigator and staff,

(4) reasonable availability of resources (equipment, etc.), and

(5) reasonableness of the proposed budget and duration of the project.

(6) other factors, such as human subjects, animal welfare, and biohazards.

During panel meetings, peer reviewers, using the above criteria, lead a discussion of applications for which they prepared written critiques. Following discussion, peer reviewers introduce a motion for each of the applications to approve, disapprove, or defer, and then the members vote openly. Some applications may be recommended for approval by the peer reviewers with a revised budget and duration. All peer reviewers then individually and privately assign each application voted worthy of approval a priority rating from one to five, one being the best. Each application's rating is multiplied by 100 and averaged to yield a priority score as a 3-digit number that may range from 100 to 500. Once the initial review group has completed this process, its formal role is over.

The advisory council members have the legislatively mandated task of recommending applications for award. In doing so, they may or may not concur with the recommendations of the initial review groups. Specifically, advisory council members are asked by the institutes to assess the quality of the initial scientific review as well as the application's relevance to institute research program goals and broader societal health-related matters.

In advance of each meeting, council members are sent briefing books that contain the initial review group's summary statements. The institute staff may bring to the attention of the council particular applications for discussion of considerations such as high program relevance or promising new areas of research. In addition, council members may raise for discussion particular applications where policy issues beyond scientific merit need to be considered. As noted in section 3, most applications are not singled out for discussion, and the Council votes concurrence with the initial review group "en bloc."

Once the council members have recommended for or against all applications, their formal role in the project selection process ends. The council members, as well as members of other NIH advisory groups, receive travel expenses, per diem, and a $100 per day honorarium for their service on the panels.

SECTION 6

What is the role of agency officials in the project selection process?

While peer reviewers advise NSF and NIH agency staff on the scientific merit of each research project application, agency staff, in turn, are responsible for (1) ensuring that the applications have been assessed in the most objective and balanced manner possible, (2) ensuring that broader agency policies and procedures are followed, and (3) recommending to agency officials at higher levels which applications should be funded.

The key agency official assigned to these responsibilities within the NSF project selection process is the program officer, while in the NIH system these responsibilities are shared by health scientist administrators, some of whom are executive secretaries of review groups and some of whom are institute program managers. We will briefly describe their roles in the award selection process.

THE NSF PROGRAM OFFICER

There are two kinds of program officers: the "rotators," who are on leave from universities to NSF for 1- or 2-year periods, and the regular career program officers, many of whom started as rotators and then stayed on. There are about 300 program officers, of whom about 100 are rotators. Because NSF rotators serve short terms as NSF program officers, it is important to describe how they are selected.

According to officials we talked with, NSF widely advertises its rotator openings and also calls people who have served on NSF review panels. Each division is expected to keep a list of possible rotators. The primary criterion for choosing rotators, according to officials, is their expertise in the scientific field. Officials told us that the selection of rotators also follows the equal employment opportunity guidelines that are applicable to all outside hires.

What the program officer or rotator does

The role of the NSF program officer or rotator includes ensuring an appropriate peer review of the application; negotiating budgets with the applicant; recommending to the Foundation which applications should be funded; and, when recommending, considering the effect of the proposed research on the nation's research infrastructure.

Selects appropriate peer reviewers

Program officers are responsible for ensuring that appropriate, qualified peer reviewers are selected and an acceptable number of peer reviewers address each of the four evaluation criteria. For example, NSF proposal guidelines state that the Foundation prefers that all proposals be reviewed by four to eight reviewers. When fewer than three are used, the program officer submits a special justification.[21]

Recommends proposals for funding

The program officer is responsible for recommending to NSF which proposals should be funded. He or she bases this recommendation on (1) the comments of external peer reviewers whose advice was sought, (2) his or her own assessment of the scientific merit of the proposal, and (3) the Foundation's wider policies governing proposal evaluation and selection.

Although program officers are not bound by external peer comments, they must, when justifying their recommendations to the Foundation in the proposal jacket, include reasons for any significant deviation from them. For example, the program officer can deviate from external peer comments to support high-risk, creative research. All recommendations are reviewed at one or more higher levels before an actual funding decision can be made.

Expected to consider
the research infrastructure

Officials in the directorates with whom we spoke said that the program officer has the responsibility of making sure that the effect of the proposed research on the infrastructure of science and engineering is considered before making a formal recommendation. By infrastructure, NSF refers, for example, to such factors as the quality of training of scientists and, in particular, the influence of the type of research on the careers of graduate students; to the development of new interdisciplinary approaches to research; and to the support of special equipment needs. NSF officials with whom we have talked have said that, in general, this criterion acts as a "swing factor" in the program officer's recommending the proposal for funding.

NIH EXECUTIVE SECRETARIES AND INSTITUTE STAFF

The NIH executive secretaries manage the initial review of the application but they do not themselves assess scientific merit. NIH institute staff manage the second level of peer

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[21]NSF Proposal and Award Manual, No. 10, section 122.3.

review, identify applications of high or low program relevance and of innovative, high-risk research, and recommend to the institute director which proposals recommended for approval by the advisory council should be funded.

Executive secretaries manage initial scientific review

NIH executive secretaries are described as experienced health scientists, hired in career positions at a senior government level, most of whom have a research and administrative background. They are no longer active researchers, as are the rotators within NSF; nearly all of them, however, have earned doctorates.

The primary responsibilities of the NIH executive secretaries are to nominate the peer reviewers for membership on panels; to officiate at the peer review panel meetings in order to ensure that NIH policies and procedures are followed; and, at the conclusion of the panel meetings, to write a summary statement for each application reflecting a balanced account of each application's panel peer review.

After initial review group meetings are completed, and the executive secretaries have prepared summary statements for each application assigned to them and forwarded them to the institutes and after they have attended advisory council/board meetings to respond to questions, their direct responsibilities end. However, if the council/board does not concur with the initial review group's evaluation of an application, it is returned to the NIH review organization for reconsideration.

Institute staff recommend application for funding

The major responsibilities of the staff of each institute in application review and selection are to assist in nominating members for vacancies on advisory councils, to identify applications with special characteristics, such as program relevancy or innovative research, and to recommend to the institute director which of the applications recommended for award by the advisory council should be funded. After the council has met, institute staff prepare a ranked "pay list" of awards that in their judgment should be made. The institute director, who makes the final funding decision, can, based on these recommendations or other criteria, also fund a council-approved application that falls below the pay line if it has high program relevance or is truly scientifically important. Appendix VI summarizes the responsibilities of both the NIH executive secretaries and the institute staff.

SECTION 7

How do NSF and NIH consider underrepresented groups of researchers, institutions, and types of research when selecting research projects for award?

Both NSF and NIH consider underrepresented groups of researchers, institutions, and types of research when selecting research projects for award. They address some or all of these areas either as part of their regular research programs or through separately budgeted programs. NSF has set targets to particularly encourage the support of women and minorities.

In this section, we will describe the mechanisms each agency has established to address four areas of special concern regarding award selection. These areas are geographic distribution of awards, underrepresented groups and institutions, innovative high-risk research, and young or new investigators.

GEOGRAPHIC DISTRIBUTION OF AWARDS

In addition to considering geographic distribution in the selection of peer reviewers (see section 4), NSF addresses geographic distribution of awards (1) by permitting the program officer to consider geographic balance when recommending project applications for funding and (2) through a centrally managed program that makes awards competitively to planning and management committees within states that have received the least federal research support over a period of time (this program is discussed in the section below). Although geography is considered in the selection of peer reviewers, NIH does not consider geographic balance when selecting competing research project applications, nor does it have any separately budgeted programs that address geographic distribution of awards.[22]

NSF's Experimental Program to Stimulate Competitive Research (EPSCOR)

The goal of NSF's Experimental Program to Stimulate Competitive Research (EPSCOR) is to increase the ability of scientists and engineers in participating states to compete successfully for federal research and development (R&D) funds by fostering long-term improvements in the research environments. NSF began EPSCOR in 1979 by giving planning awards to a state-wide group of scientists, engineers, and administrators in each of seven states that ranked lowest in R&D funding. The group had

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[22]NIH does, for technical reasons, consider geography in some of its control and prevention initiatives, which may look at, for example, the relationship between groups of people in specific regions and certain incidences of cancer.

9 months to assess the state's science and technology base and to develop a 5-year research improvement plan. This plan could request up to $3 million.

Two rounds of planning awards have resulted in 5-year EPSCOR grants to groups in 12 states and 1 territory. In October 1980, NSF awarded such grants in Arkansas, Maine, Montana, South Carolina, and West Virginia. In August 1986, NSF awarded grants in Alabama, Kentucky, Nevada, North Dakota, Oklahoma, Puerto Rico, Vermont, and Wyoming. The 13 grants, ranging from $2.4 million to $3 million each, totaled $36.9 million over a 5-year grant period.

NSF EPSCOR program officials told us that they are finding improvement in the ability of participants to compete nationally as a result of EPSCOR funding. For example, South Carolina received an EPSCOR award in 1980. In 1978, it had $900,000 in NSF competitive research program support (ranked 46th among all states). In 1986, it had $6.2 million and ranked 29th in NSF funding. Montana also increased its NSF awards markedly as a result of its EPSCOR program.

UNDERREPRESENTED GROUPS AND INSTITUTIONS

For purposes of this report, "underrepresented groups" are defined as ethnic minorities and women; "underrepresented institutions" are defined as predominantly undergraduate institutions, including small non-doctoral-granting liberal arts colleges and institutions granting a few doctoral-level degrees. Both NSF and NIH have special mechanisms for addressing some or all of these areas.

NSF--Underrepresented researchers and institutions

NSF has a variety of mechanisms to encourage underrepresented groups and institutions. First, the general NSF evaluation criteria that apply to all proposals permit the program officers to consider underrepresented groups and institutions when recommending proposals for funding, and when selecting peer reviewers. Second, the Foundation puts out special announcements that are coordinated by a central group and that incorporate special program objectives regarding underrepresented groups and institutions into research program objectives. These programs have Foundation-set funding targets or goals. Third, research directorates have set aside funds to help in meeting these targets.[23] Fourth, NSF has several

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[23]Fiscal year 1986 NSF data show that, although NSF varied by individual research directorate in meeting its targets for new

separately budgeted programs for women and minorities. Appendix VII shows a breakdown of these mechanisms and the funding estimated for each.

NIH--Underrepresented researchers and institutions

NIH has separately budgeted programs to encourage participation by minorities, minority institutions, and small colleges in its biomedical research activities. In addition, officials have estimated the extent to which women and minorities are supported through competing research project awards. Altogether, NIH estimates that it awarded women investigators about 13 percent and minority investigators approximately 9 percent of its competing research project obligations in fiscal year 1986. Appendix VIII contains a summary of the programs and levels of support.

INNOVATIVE, HIGH-RISK RESEARCH

A task force of the National Science Foundation Advisory Council identified three classes of "innovative high-risk" research: (1) research that challenges currently accepted scientific hypotheses and can lead to great advances in scientific knowledge (i.e., innovative), (2) research that transfers knowledge from one scientific field to another (i.e., interdisciplinary research), and (3) research that is at the edge of technical feasibility (i.e., risky projects that, if successful, would have high pay-offs). We will describe mechanisms NSF and NIH have for addressing each of the above areas.

NSF--Innovative, high-risk research

NSF officials said they encourage innovative, high-risk research through their regular award review process. As discussed in section 5, one of NSF's four general criteria for evaluating all applications permits a consideration of the potential of the proposed research for improving the scientific and engineering enterprise. Included in this goal are the stimulation of quality activities in important or underdeveloped fields and the use of interdisciplinary approaches to research in appropriate areas. According to NSF officials, program officers are encouraged to seek out especially innovative proposals and consider them for funding. One high NSF program official said she looks for how innovative proposals are treated when she reviews program officers' recommendations.

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minority researchers, women, and predominantly undergraduate institutions, overall, NSF was either close to meeting or exceeded its target in all three areas.

Some NSF programs have specific mechanisms to fund innovative research. The Engineering Directorate has an experimental program called Expedited Awards for Novel Research. It allows a program officer to spend up to 5 percent of his or her budget on proposals that reflect new ideas. The grants are for 1 year, and since there is no external peer review, the program can respond quickly to new ideas. The Engineering Directorate also has a mechanism for funding "innovative and exceptional proposals" that are high risk, highly innovative, or interdisciplinary. In fiscal year 1985, eight proposals were funded for a total of $2 million. Finally, an NSF mechanism called Creativity Extension allows grants for projects that are judged to be truly creative to be continued for two additional years without having to be competitively renewed.

NSF has other mechanisms specifically meant to aid interdisciplinary research. For example, NSF program directors in various scientific disciplines can directly stimulate interdisciplinary proposals by issuing special announcements in areas that combine technology with social issues, such as biotechnology or robotics and automated manufacturing. Also in the field of interdisciplinary research, the Engineering Directorate has an office of Engineering Infrastructure Development for coordinating the review of proposals that span the interests of several of its programs.

NIH--Innovative, high-risk research

NIH officials told us that they try to support innovative, high-risk research through their regular competitive research project application program. In addition, NIH identified one activity called Small Grants that emphasizes one or more of the following purposes: pilot projects, testing of new techniques, and feasibility studies of high-risk research. The Small Grants activity also supports the following types of investigators: (1) recently trained or less-experienced investigators whose research careers were interrupted and are intended to be resumed, (2) investigators changing fields of research, (3) investigators at minority institutions or located in a largely nonresearch environment, and (4) established investigators needing quick support for a pilot project. In fiscal year 1985, this activity was provided agency funds of almost $4 million and made 191 awards.

NEW OR YOUNG INVESTIGATORS

Both NSF and NIH have separately budgeted programs addressing new (first time in the system) or young investigators.

NSF--New investigators

NSF identified several programs for young or new investigators. First, several of the NSF directorates reported separate programs for new investigators such as the Engineering Initiation Awards that provide an opportunity for recently appointed assistant or associate professors to initiate academic engineering research. This mechanism is directed toward full-time engineering faculty members who have had no prior substantial research support. In fiscal year 1984, NSF funded $9 million and made 227 awards for initiation grants in Engineering and Information Science. Second, the NSF Presidential Young Investigators Award program provides initial support for promising young scientists and engineers. In fiscal year 1984, NSF funded about $24 million and made 200 awards under this program. (App. VII also describes programs for new women and new minority investigators.)

NIH--New investigators

NIH established in fiscal year 1986 a First Independent Research Support and Transition (FIRST) Award to provide a sufficient initial period of research support for newly independent biomedical investigators to develop their research capabilities and demonstrate the merit of their research ideas. These grants generally will be for 5 years. They replace the NIH New Investigator Research Award that funded 812 awards in fiscal year 1984 at a level of $40 million.

SECTION 8

How do NSF and NIH attempt to maintain the openness of and monitor the fairness of their project selection systems?

NSF and NIH have a number of specific procedures that attempt to maintain the openness of and monitor the fairness of the peer review system. We have identified in the previous three sections a number of these procedures that are built into both the selection of peer reviewers and the evaluation of proposals. This section will identify those procedures not previously discussed.

MAINTAINING OPENNESS

Maintaining openness refers to mechanisms that give the applicant feedback during or after the award selection process. First, both agencies make peer review evaluations available to the applicant. NSF automatically sends anonymous verbatim peer review comments to the applicants. NIH sends a summary statement to the investigator with the priority score displayed. Both agencies assert that sending reviewer comments to the principal investigators is a good training device to help the applicant in reassessing, adjusting, or improving his or her research program objectives.

Second, NSF and NIH have processes whereby an applicant can challenge the agency's decisions and ask that the application be reconsidered. In the NIH peer review appeals system, the principal investigator first expresses his or her disagreement with the process and/or substance of the review to the institute directly responsible for the management of the application. If the principal investigator seriously disagrees with the response made by the institute, the investigator and the applicant organization may jointly appeal to the Office of Extramural Research and Training, a component of the Office of the Director, NIH. The decision on an appeal is made at the highest level of NIH and it is final.

An NSF applicant whose proposal has been declined may obtain an explanation from the responsible program officer. If this explanation does not satisfy him or her, the applicant may also obtain reconsideration of the declination from several higher levels. (Reconsideration is an examination to determine if the decision on the proposal was arrived at properly in accordance with Foundation policies.) However, neither NSF nor NIH can assure applicants that reconsideration will result in an award even if error is established in connection with the initial evaluation.

MONITORING FAIRNESS

Fairness refers to mechanisms that have the purpose of assuring that an investigator's application received an objective or unbiased review. According to NSF officials, NSF monitors fairness when the program officer's award recommendations are reviewed by higher level officials. In addition, NSF "tests" the system post-award by both external and internal reviews. NIH, on the other hand, relies on the checks and balances of the dual review process and internal oversight, as needed, to validate the system's fairness.

NSF--Monitoring fairness

NSF has four procedures for monitoring fairness: (1) a pre-award division-level review of each proposal recommendation made by the program officer,[24] (2) post-award internal oversight, (3) post-award external oversight, and (4) statistical "fairness" evaluations by internal evaluation staff.

First, according to written NSF procedures, program officers' recommendations are routinely reviewed by the section head, if any, and by the division director to verify that the number and quality of the peer reviewers are adequate; that significant peer review comments contrary to the recommendation have been properly accounted for; and that the rationale for the recommendation is reasonable. Second, the staff of the Director's Office of Audit and Oversight routinely examines a small, random sample of awards for compliance with NSF policies and procedures and provides direct feedback to the program division. Third, every program is comprehensively reviewed every 3 years by a small group of external peers familiar with the field. These "visiting committees" make publicly available formal reports to the NSF director about each program.[25] Fourth, NSF's program evaluation staff, which is independent of the program divisions, has run various statistical tests to see if the system has been "fair" to certain classes of applicants. (See sec. 10 for discussion.)

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[24]As discussed in section 7, NSF also has targets to encourage fairness and has recently created set-asides to ensure that these targets are met.

[25]NSF has prescribed a set of questions that an external peer oversight committee must address when conducting its review and when reporting its findings. The questions cover such areas as the selection of an appropriate number of technically qualified reviewers; the reasonableness of the program officer's recommendation; and evidence of significant imbalance in various factors, including geographic distribution of principal investigators.

NIH--Monitoring fairness

An NIH policy document states that objectivity in the award decision process is enhanced by

-- separating reviews for scientific and technical merit from reviews for program needs;

-- separating internal staff responsibility for scientific review from internal staff responsibility for program administration;

-- reviewing a proposal's scientific merit on two levels, thereby providing a system of checks and balances (dual review); and

-- continuous quality control and oversight of study section reviews by experienced senior staff who visit study section meetings and review samples of summary statements.

Several senior staff committees share responsibility for systematic, ongoing oversight of NIH's peer review system. For example, the Review Policy Committee reports to the Director of NIH, meeting monthly to share and discuss the progress of the initial review process. If NIH peer review problems surface within this oversight group, they recommend options for action to the NIH Director's office.

SECTION 9

What are the key similarities and differences between the NSF and NIH systems for granting research awards to universities?

This section summarizes the main similarities and differences between the NSF and NIH project selection systems. Appendix IX presents a chart comparing the award procedures of the two agencies.

1. The overall project selection process. Both NIH and NSF emphasize scientific merit when selecting among competing research project applications. Both agencies rely on the advice of external peer reviewers to determine such merit. NSF, however, permits its program officers, many of whom are on 2-year rotational assignments from their active research positions outside NSF, to contribute to the evaluation of proposals for scientific merit, while NIH relies almost exclusively on its external peer reviewers.

NSF uses a variety of peer review procedures, such as panels, ad hoc mail, and a combination of both. These procedures vary as much across NSF research directorates as they do within them. NIH, on the other hand, primarily uses the panel procedure with occasional use of ad hoc mail and a combination of panel and mail. Both agencies rely upon in-house staff to make final funding recommendations and decisions.

2. Selection of peer reviewers. NSF and NIH written criteria for selecting peer reviewers emphasize their scientific expertise. They also have selection criteria that consider factors such as underrepresented groups and geographic balance. NIH, unlike NSF, requires that a specific percent of peer reviewers serving on study sections be women and minorities, and that they represent a certain regional and state balance.

3. Role of peer reviewers in project selection. Both NSF and NIH ask peer reviewers to advise them on the scientific and technical merit of project applications. NIH also asks peer reviewers to (1) recommend changes in budget and duration of approved applications, (2) numerically rank those proposals considered worthy of funding, (3) identify applications of high or low program relevance, and (4) recommend project applications for award, as statutorily mandated.

4. Role of agency officials in project selection. Both NSF and NIH program officials make the final funding decisions. In this regard, NSF program officers formally recommend proposals for funding, and NIH institute staff construct pay lists based primarily on priority scores. NSF program officers, a third of which are "rotators" with recent research experience, evaluate

the scientific merit of proposals, whereas NIH officials rely on external peers for such an assessment.

5. Special infrastructure concerns. Both NSF and NIH have mechanisms to take into account underrepresented researchers and institutions as well as innovative, high-risk research when making research awards. NSF has set targets for some of these infrastructure areas.

6. Monitoring and oversight. In addition to agency review at higher levels, NSF relies on post-award review and oversight to assure the fairness and openness of its award selection system, while NIH relies on the checks and balance of the "dual review" system as well as regular quality control.

SECTION 10

What have past studies concluded about the fairness and effectiveness of peer review in awarding research funds to university scientists?

Studies of past awards, surveys of scientists, and commission reports have endorsed the continued use of peer review and have not identified significant amounts of bias in the awards. However, a number of scientists believe there is some "cronyism." Only a few studies have attempted to evaluate the reliability and effectiveness of peer review in selecting research to be funded.

Major studies of health or biomedical research by presidential commissions or panels of distinguished scientists have endorsed the continued use of peer review as a very effective way to select awards for university researchers. In addition, surveys over the last 10 years have similarly endorsed peer review. For example, of the approximately 4,100 scientists responding to a 1986 Sigma Xi survey, 86 percent agreed that the government should use peer review to assure quality in its research programs. (See app. I for a selective list of these surveys and reports.)

FAIRNESS

Fairness addresses whether the system exhibits any bias toward the applicant related to such factors as age, sex, ethnic status, and the prestige or geographic location of his or her institution. By bias, we mean that peer reviewers or agency program staff, when faced with "two equally good proposals," would choose, for example, the one from a more well-known institution or from a more well-established researcher.[26] The perception that such a condition exists has prompted the accusation of the system being an "old boys' network," or exhibiting "cronyism." Although scientists overwhelmingly appear to endorse the continued use of peer review, there is a perception based on a number of surveys that some unfairness exists in the system. Analyses of NSF award decisions, however, do not provide conclusive statistical evidence to support these perceptions.

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[26]This concept of "fairness" is derived in large part from Grace Carter's A Review of the Literature Concerning the NSF Peer Review System, prepared for the Division of Policy Research and Analysis, National Science Foundation, July 18, 1986, p. 3.

Surveys

As described in section 2 of this fact sheet, over 60 percent of the scientists surveyed by a 1986 Sigma Xi survey believed that receiving federal research funds was based on "who you know" and knowledge of prior research work by the granting agency. (However, over 40 percent of the respondents were from industry and government and their perspectives were not reported separately from university scientists, nor is it clear how much experience with the academic research award process they had had.)

Twenty-eight percent of the scientists who had served on NIH public advisory groups surveyed in a 1976 NIH peer review study believed the NIH system to embody a moderate or higher degree of cronyism.[27] (The frequency of this behavior by participants in the NIH process was not noted, nor has GAO independently evaluated whether subsequent changes in the NIH selection of reviewers or procedures related to peer review have diminished the occurrence of favoritism entering into award decisions.)

Another survey of a sample of about 300 applicants for research support from NIH's National Cancer Institute in 1980 and 1981[28] showed that approximately 40 percent agreed or strongly agreed that the initial review groups were controlled by "old boy networks"; a little over 25 percent were undecided on this. Similarly, 35 percent agreed or strongly agreed that reviewers are biased against researchers in nonmajor universities or institutions in certain regions of the United States; 34 percent of the respondents were undecided on this issue. In comparison, 17 percent and 5 percent either agreed or strongly agreed that reviewers are biased against young researchers, or against women

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[27]Survey of the NIH Grant Peer Review System. Analysis of Survey Responses and Comments, U.S. Department of Health, Education, and Welfare, National Institutes of Health, July 1, 1977, p. I-26.

[28]The survey was performed by Gillespie, Chubin, and Kurzon and published as "Experience with NIH Peer Review: Researchers' Cynicism and Desire for Change" in Science, Technology, and Human Values, Vol. 10, Issue 3, Summer 1985, pp. 44-54. In interpreting their views on NIH peer review, it is important to note the percentage of respondents that characterized their previous success in obtaining research funding as: 62 percent successful or highly successful (more proposals funded than declined), 22 percent mixed success (no more than half of previous proposals funded), and 16 percent unsuccessful (no prior proposals funded).

and minorities, respectively. A survey by NSF of the views of the peer review process by all the researchers who applied for funds from NSF during fiscal year 1985 (whether declined or awarded) will be completed early in 1987.

Analyses of NSF award decisions

Analyses of NSF award decisions during the past 10 years showed that:

-- There is no conclusive statistical evidence that reviewers for NSF are biasing their reviews of proposals based on the applicant's age, or gender, or the geographic location or prestige of the applicant's institution.[29] (There were no data on racial background of the applicants.)

-- Peer reviewers give substantially better ratings to renewal applications than to first-time applications, and women and young investigators constitute a smaller proportion of renewal applications than of first-time applications. The degree of higher ratings on renewals may be appropriate, since they were judged of high quality when first awarded.

-- The ratings provided by the peer reviewers are the most important influence on the program officer's award recommendation.

-- Evidence is mixed on whether the amount of research done by an applicant's institution has an effect on the NSF program officer's recommendation, with two studies offering opposing conclusions.

-- There is no firm answer on whether geographic region independently affects program officer's decisions.

RELIABILITY AND EFFECTIVENESS

Reliability refers to the role of chance in determining the outcome of the NSF award decision process and focuses on the degree to which there is consensus regarding the scientific merit

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[29]This summary of statistical evidence is based in large part on "A Review of the Literature Concerning the NSF Peer Review System" by Grace Carter, prepared for the Division of Policy Research and Analysis, NSF, July 1986. We also rely on the findings of the report by Cole, et. al., performed for the National Academy of Sciences and the 6 "fairness studies" which were performed by the NSF evaluation staff (listed in app. I).

of individual proposals. Effectiveness refers to the outcome of projects selected for funding (i.e., Did they promote the "best" science?). There have been few studies of the reliability and effectiveness of peer review. Two studies performed on past NSF funding decisions, on actions by NSF program officers during fiscal year 1976 and fiscal year 1981, respectively, found that reviewers disagree on the quality of proposals across the entire range of proposals, in that a new set of reviewers more than a year later would have reversed about a quarter of the original NSF funding decisions.[30] Thus, some have argued that chance can play a significant role in whether a proposal gets funded since a different group of reviewers may come to an alternate conclusion.

As for the effectiveness of peer review, studies have shown the share of significant advances in a particular field of science, for example in chemistry, that have been supported by NSF. We are not aware, however, of studies that have compared the quality of research supported by NSF as a result of peer review of proposals and the research supported by other government or private organizations that do not rely on peer review in the same way.

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[30] Ibid, p. 17. The Carter review cites the 1981 Cole study and the NSF Evaluation Staff Study 82-1 (see Appendix I).

SELECTED BIBLIOGRAPHY OF STUDIES OF PEER REVIEW

The Administration of Government-Supported Research at Universities (the "Westrate report"), 1966.

Biomedical Science and its Administration: A Study of The National Institutes of Health, Report to the President (the "Wooldridge report"), 1965.

Carter, G.M. Peer Review, Citations, and Biomedical Research Policy: NIH Grants to Medical School Faculty. Department of Health, Education, and Welfare/the Rand Corporation, R-1583-HEW, Dec. 1974.

Carter, G.M. A Review of the Literature Concerning the NSF Peer Review System. Prepared for the Division of Policy Research and Analysis, National Science Foundation, July 1986.

Carter, G.M. What We Know and Do Not Know About the NIH Peer Review System. National Institutes of Health/the Rand Corporation, N-1878-RC/NIH, June 1982.

Cole, J.R., and Cole, S. Peer Review in the National Science Foundation, Phase 2. Washington, D.C.: National Academy Press, 1981.

Fairness of the NSF Award Decision Process, Fiscal Year 1982. Evaluation Staff Studies 84-1, National Science Foundation, Jan. 1984.

Fairness of the NSF Award Decision Process, Fiscal Year 1983. Evaluation Staff Studies 85-1, National Science Foundation, Mar. 1985.

Final Report. NSF Advisory Committee on Merit Review. National Science Foundation, September 25, 1986.

Geographic and Institutional Effect on the Award Decision, Evaluation Staff Studies 81-2. National Science Foundation, Nov. 1981.

Grants Peer Review: Opinions on the NIH Grants Peer Review System, Phase II of the Report to the Director, NIH. National Institutes of Health, Dec. 1978.

Investigation of the National Institutes of Health. Committee on Interstate and Foreign Commerce, U.S. House of Representatives, Washington, D.C.: U.S. Government Printing Office, Aug. 1976.

National Science Foundation Peer Review: Special Oversight Hearings. Subcommittee on Science, Research, and Technology, Committee on Science and Technology, U.S. House of Representatives. Washington, D.C.: U.S. Government Printing Office, 1975.

A New Agenda for Science (preliminary report). New Haven, Conn.: Sigma Xi, The Scientific Research Society, 1986.

The NSF Post-Performance Evaluation Study, Evaluation Staff Studies 84-2. National Science Foundation, 1984.

Steelman, John R. The Nation's Medical Research. (Volume 5 of Science and Public Policy, A Report to the President), 1947.

Report of the President's Biomedical Research Panel (established pursuant to Public Law 93-352.), 1976.

Report of the Secretary's Advisory Committee on the Management of NIH Research Contracts and Grants (the "Ruina report"). U.S. Department of Health, Education, and Welfare, 1966.

Reviewer and Proposer Similarity and its Effect on Award Decisions, Evaluation Staff Studies 76-1. National Science Foundation, 1976.

Review Processes: Assessing the Quality of Research Proposals. Washington, D.C.: the National Commission on Research, May 1980.

A Study of the Fairness of the NSF Award Decision Process, Evaluation Staff Studies 82-1. National Science Foundation, Aug. 1982.

RESOURCES USED BY NSF WHEN RECRUITING PEER REVIEWERS

- Computerized lists or files of potential reviewers.
- Lists of suggested reviewers sent by the applicants themselves.
- Authors of publications containing related research cited as part of the proposal.
- Current literature in the area of the proposal.
- Other reviewers who have served NSF.
- Program officer's knowledge of other researchers in the field.
- Contacts made by NSF staff at professional meetings.
- Speeches and visits made in connection with NSF "outreach" efforts to undergraduate institutions, minority institutions, and other types of institutions.

Source: NSF officials.

NSF CRITERIA FOR SELECTING PEER REVIEWERS

- Peer reviewers should have
  - -- special knowledge of the science and engineering fields,
  - -- broader or more generalized knowledge of the science and engineering fields, and
  - -- broad knowledge of the infrastructure of the science and engineering enterprise and its educational activities.
- To the extent possible, reviewers should reflect a balance among various characteristics such as geography, type of institution, and underrepresented groups.
- Reviewers should be chosen in accordance with NSF conflict-of-interest rules and standards of conduct to avoid bias in the review of proposals.
- Too frequent use of any one reviewer or institution must be avoided.
- Additional criteria for selecting reviewers who serve on panels:
  - -- Age distribution. Members should be selected from as broad a range of age groups as is feasible.
  - -- Regular rotation. Members can serve a maximum of 3 years.
  - -- Academic and nonacademic impact. Members should represent different size, as well as public and private institutions. Whenever possible, concurrent or successive appointments of individuals from the same institution should be avoided. Representatives from outside the academic community are also desirable in some instances.
  - -- Public impact. Where pertinent, some members should be representative of regions, organizations, or segments of the public directly affected by issues under consideration.

Source: NSF Proposal and Award Manual.

RESOURCES USED BY NIH WHEN RECRUITING PEER REVIEWERS FOR INITIAL PEER REVIEW COMMITTEES

- Knowledge of the executive secretary of the committee of the field and the scientists who work within it.
- Executive secretary's contacts at scientific meetings.
- Institute staff recommendations.
- Research grant applications and awards.
- Research publications.
- Recommendations of the members of the initial peer review committees.

Source: NIH officials.

NIH CRITERIA FOR SELECTING PEER REVIEWERS

- Peer reviewers must have demonstrated competence and achievement as independent investigators.

NIH peer reviewers must meet the following requirements:

- -- No more than one member per institution.
- -- The goal of membership is at least 17 percent ethnic minority and 23 percent female.
- -- No more than 15 percent membership may be from each of four states: New York, California, Massachusetts, and Texas. Section membership is suggested to be no more than 10 percent from all other states individually.
- -- No more than 50 percent membership may be from any one of four geographic regions: South, Central, East, and West.[a]
- -- No more than one federal employee except in unusual circumstances.[a]
- -- A year must lapse before a committee member can be reappointed to serve on the same or any other committee.
- -- No excessive service, as defined by an individual serving more than a total of 8 years in the past 12 years.
- -- After a member completes the term, a year must elapse before a member can be appointed from the same institution.[a]

Source: NIH officials and NIH written documents.

[a]Only a requirement for serving on initial review groups (study sections) with NIH's Division of Research Grants.

RESPONSIBILITIES OF NIH EXECUTIVE SECRETARIES AND INSTITUTE STAFF IN AWARD SELECTION

o NIH EXECUTIVE SECRETARIES

- -- Identify and nominate the peer reviewers to serve on panels, orient new members.
- -- Prepare agenda of the study section meeting.
- -- Identify proposals that are special or incomplete and obtain additional information, as needed.
- -- Assign proposals to primary and secondary reviewers and ensure against conflict of interest.
- -- Administer the peer panel meetings to ensure they are conducted in accordance with NIH policy and procedures.
- -- Write the summary statements that are the official agency record of the evaluations and recommendations made by peer reviewers and contain, among other things, the review group's vote, priority scores, and summaries of their critique.
- -- Administer the site visits by peer reviewers on larger projects, if necessary.

o INSTITUTE STAFF

- -- Nominate council members for vacancies on the advisory council and orient new members.
- -- Identify applications whose priority score would not be in the fundable range, but whose program relevance, uniqueness, or potential impact merit recommending funding.
- -- Prepare advisory council briefing books that contain the initial review group summary statements, and indicate those proposals marked for special consideration.
- -- Recommend to the Director which applications that have been approved by the Council should be funded.

Source: NIH officials and documents.

NSF SUPPORT FOR UNDERREPRESENTED GROUPS AND INSTITUTIONS

Mechanism	Program title	Goal	FY 1986 funding (millions)
MINORITY INVESTIGATORS AND INSTITUTIONS			
Targeted programs	Minority Research Initiation (MRI)	To provide support to allow researchers who have never received federal research support as faculty members to establish independent research projects	$2.6
Separately budgeted programs	Minority Research Centers of Excellence (MRCE)	To increase the minority presence in science and engineering by upgrading the research capabilities of the strongest and most productive minority institutions. New in FY 1987. Estimated support: $4 million	
	Research Improvement in Minority Institutions (RIMI)	To help institutions with sizable minority enrollments increase their research and research-related training capabilities	5.0
Additional research program support	Minority Investigators	Support for Minority Investigators through the regular competitive research programs	6.6
	Minority Institutions (includes Historically Black Colleges)		12.8
Total support to minority investigators and institutions			$27.0

APPENDIX VII

Mechanism	Program title	Goal	FY 1986 funding (millions)
PREDOMINANTLY UNDERGRADUATE INSTITUTIONS			
Targeted programs	Regular program support	Support for research and instrumentation proposals submitted directly to the regular disciplinary programs	$37.5
	Research in Undergraduate Institutions (RUI)	To strengthen the research environment in undergraduate academic departments within predominantly undergraduate (nondoctoral) institutions	10.7
	Research Opportunities Award (ROA)	Provide opportunities for faculty at undergraduate institutions to participate in research under aegis of NSF investigators at major research institutions	1.6
Total support to predominantly undergraduate institutions			$49.8

APPENDIX VII

Mechanism	Program title	Goal	FY 1986 funding (millions)
WOMEN			
Targeted programs	Research Opportunities for Women (ROW)	To increase the numbers of women as full participants in the mainstream of the nation's research enterprise through research initiation planning and career advancement grants	$2.0
Separately budgeted programs	Visiting Professorships for Women (VPW)	To enhance women's participation in science and engineering by enabling women scientists and engineers experienced in independent research to serve as visiting professors	2.0
Additional research program support	Women Investigators	Support for women investigators through the regular competitive research programs	63.5
Total research support to women investigators			$67.5

Source: NSF officials and internal documents.

NIH SUPPORT FOR UNDERREPRESENTED GROUPS AND INSTITUTIONS

Program	Goal	No. of awards	FY 1986 funding (millions)
Minority Biomedical Research Support Program	Promote minority faculty and student participation in biomedical research and strengthen biomedical research capabilities at eligible institutions	107	$32.3
Research Centers in Minority Institutions	Enhance capacity of doctoral degree-granting minority institutions to conduct biomedical and/or behavioral research by strengthening their research environment	16	9.8
Minority Access to Research Career	Address the research training of ethnic minorities in the biomedical sciences	81	7.2
Academic Research Enhancement Program	Stimulate research in smaller, less prominent colleges and universities that provide undergraduate and graduate training for a significant number of our nation's research scientists but that have not shared adequately in the growth of NIH extramural awards	184	12.1

APPENDIX VIII

Program	Goal	No.of awards	FY 1986 funding (millions)
Minority High School Student Research Apprentice Program	To provide meaningful experience in various aspects of health-related research in the expectation that some apprentices will decide to pursue careers in biomedical research	299	1.5
Minority Biomedical Research Support Thematic Project Grants	To promote increased faculty and interdepartmental collaboration through programs that focus on specific research themes or scientific disciplines at developing minority institutions. These grants are intended to strengthen the biomedical research capability in defined areas and to attract other competent biomedical scientists through an improved research environment.	4	1.0
Minority Biomedical Research Support Grant Program for Undergraduate Colleges	To enrich the research environment at eligible undergraduate institutions with the purposes of motivating students toward biomedical research careers and providing faculty with opportunities to participate in biomedical research	10	1.0
Total FY '86 support			$64.9

NIH Support for Minorities and Women on Competing Individual Research Projects, FY 1986 [a]

	Estimated support [b] (in thousands)
Total	$919,470
Percent of total	100.0
Minorities	$85,511
Percent of total	9.3
Women	$122,290
Percent of total	13.3
Women or minorities	$199,525 c
Percent of total	21.7

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[a]Limited to research applications that were peer-reviewed during fiscal year 1986 (i.e., new awards, competitive renewals, and competing supplements).

[b]Estimates are made for nonresponses.

[c]Because there is some overlap between the "women" and "minorities" categories, these categories don't add up to "women or minorities."

Source: NIH officials.

COMPARISON OF NSF AND NIH PROJECT SELECTION SYSTEMS

Proposal selection procedures	NSF	NIH
Use of peers to determine scientific merit	Y[a]	Y
Dominant peer review method(s):		
Panel	N[b]	Y
Ad hoc mail	Y	N
Ad hoc mail and panel	Y	N
Funding recommendations made by:		
Peer reviewers	N	N
In-house officials	Y	Y
Funding decisions made by:		
Peer reviewers	N	N
In-house staff	Y	Y
Selection of peer reviewers		
Written criteria for selection	Y	Y
Criteria emphasize scientific expertise	Y	Y
Criteria state numerical goals/requirements for:		
Geographic balance	N	Y
Institutional balance	N	Y
Women and minorities	N	Y
Length of service	Y	Y
Role of peer reviewers		
Provide scientific and technical review	Y	Y
Evaluate program priorities/relevance	N	Y
Recommend proposal budget and duration	N	Y
Recommend approval of proposal for award	N	Y
Numerically rate proposal	Y	Y
Make funding decisions	N	N
Role of agency officials		
Select peer reviewers	Y	Y
Evaluate proposals for scientific merit	Y	N
Recommend proposal for funding	Y	Y
Make funding decision	Y	Y

[a]Y=yes.
[b]N=no.

Research infrastructure	NSF	NIH
Agency considers the following when funding projects:		
Geographic balance	Y	N
Targets	Y	N
Underrepresented groups	Y	Y
Targets	Y	N
Less research-intensive institutions	Y	Y
Targets	Y	N
Innovative, high-risk proposals	Y	Y
Targets	N	N
Young and new researchers	Y	Y
Targets	N	N
Oversight and monitoring		
Agencies routinely provide the following to ensure system's fairness and openness:		
Central computer file of peer attributes	Y	Y
Regular rotation of peers	Y	Y
Conflict-of-interest rules	Y	Y
Peer evaluations sent to applicant	Y	Y
Appeals process for applicants	Y	Y
External oversight	Y	N
Internal audit/evaluation	Y	Y
Centrally monitored targets	Y	N

Source: NIH and NSF agency officials and documents.

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